International Convergence of Copyright Production

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Abstract

The production of copyrighted materials varies widely across countries, and how it evolves over time has important policy implications. I propose a simple dynamic model of copyrights and the public domain, which predicts conditional convergence of per capita copyright production among countries. Using book and film production data for the period 1975–1995, I test and confirm the model's prediction that copyright poor countries tend to grow faster than copyright rich countries in terms of per capita copyright production.

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1 Introduction

Authors and artists produce creative works that contribute to the world's stock of copyrighted materials. In the past, some countries have produced more copyrighted works than others. This paper examines whether the gap between the countries' per capita production of copyrighted material (hereafter copyright production) is likely to grow or shrink. To do so, I describe a simple model that captures the evolution of copyright production, test the model's prediction, and discuss its policy implications.

A copyright is an exclusive right given to the creators of original works for a certain period whereby they can reproduce, sell, or distribute the material. When the copyright expires, the work falls into the public domain. Works in the public domain are available for use by anyone, but some of the public domain works become obsolete due to cultural and technological changes. The production of copyrighted goods often is a measurable concept, although the size of the public domain may be harder to measure.

For example, the United States Copyright Office has the records of all copyright registrations in the U.S. since 1870. Figure 1 shows that the total and per capita number of annual copyright registrations in the U.S. have increased sixfold and doubled, respectively, over the last century.[1] Whether this growth trend will continue or slow down and how it compares with those of other countries has important implications for a country's stance towards international copyright policies and harmonization.

There is indeed a large variation across countries in the production of copyrighted goods.

[1] When the U.S. started implementing the Berne Convention in 1989, the copyright registration requirement was eliminated, so the number of registrations are almost certainly lower than the true number of copyright productions in the 1990s.

An international comparison of the number of total copyright registrations is not available due to the lack of data; however, it is often possible to compare the production of certain subject matters (e.g., books, movies, music), most of which are initially copyrighted. For example, using a panel of 26 OECD countries over the period 1991–2002, Png and Wang (2006) show that there is a substantial difference between the countries' per capita movie productions. A key issue that concerns international copyright policy is whether this production gap would narrow.

Copyright harmonization refers to the fact that national copyright policies have been greatly influenced by multilateral international treaties.[2] Because countries may have different initial levels of copyright production, the same copyright policy might lead to divergent growth paths. Thus, the one-size-fits-all approach would be justified only if countries with an initially low level of copyright production tend to produce at a higher rate than those with an initially high level of copyright production. In other words, a convergence of per capita copyright production would provide a rationale for copyright harmonization.

After briefly reviewing relevant literature, I lay out a dynamic model of copyright production and the public domain and show that the dynamical system is asymptotically stable in the sense that regardless of the initial condition, per capita stock of copyrighted material and that in the public domain converge to the same steady-state level. I then test the (un)conditional convergence hypothesis using a 5-year panel data of book and film production for 39 and 29 countries, respectively, over the period 1975–1995, as well as a 4-year

[2] The 1886 Berne Convention is the first international agreement that provided reciprocal national treatment of copyright protection. A somewhat weaker version is the Universal Copyright Convention, adopted at Geneva and Paris in 1952 and 1971, respectively. Recently, the Agreement on Trade-Related Aspects of Intellectual Property Rights (1994) and the World Intellectual Property Organization Copyright Treaty (1996) require member countries to create strict intellectual property systems.

panel data for 25 countries over the period 1990–1998. The empirical results support the model's prediction.

2 Relevant Literature

There is a growing literature on copyright which emphasizes the supply response to changes in copyright policies (e.g., Liebowitz and Margolis 2005).[3] Hui and Png (2002) and Png and Wang (2006) provide empirical evidence that recent copyright term extensions were associated with increased production of movies among OECD countries. Landes and Posner (2003) and Khan (2004) show that earlier term extensions did not have a significant effect on the number of copyright registrations in the U.S. This paper contributes to this literature by analyzing the growth path of copyright production in different countries over the last 20 years.

This paper is related to the work of Boldrin and Levine (2009), who show that the elasticity of revenue with respect to the marginal idea is increasing as the market size increases, so that the optimal level of copyright protection should decrease as the market size increases over time. Similarly, Scotchmer (2004) finds that with copyright harmonization small countries will favor stronger copyright protection than large countries because they gain from the exposure to a large foreign market. I reach a similar conclusion in that copyright poor countries may prefer stronger copyright protection in order to grow at a higher speed.

This paper builds upon the literature on economic growth. While the substantive issues are different, the modeling and empirical tests bear a close relationship to the cross-country

[3] The economic literature on copyright has focused on static or steady-state analyses. See Peitz and Waelbroeck (2006) and Towse et al. (2008) for recent surveys of the broader literature.

convergence literature (e.g., Baumol 1986; Barro 1991), where a number of authors have shown that, after controlling for parameters of preferences and technology, poor income countries tend to grow faster than rich countries. The current paper shows that the framework of the economic growth model can be applied to copyright dynamics, or more generally knowledge production, where the evolution of copyright and the public domain plays an important role.

3 Dynamical System

The model focuses on the evolution of two key variables, C_t or the stock of copyrighted works at time t and P_t or the stock of works that are in the public domain at time t. Copyrights are protected for a certain duration of terms, but at the same time the level of effective protection depends on law enforcement and copying technologies. That is, even if an item's copyright has not expired, it could fall into the public domain if the copyrights are not enforced. Thus, C_t represents the economy's accumulated stock of works at time t that are effectively copyright protected. Likewise, P_t represents the accumulated stock of works at time t that have entered the public domain.

At any time, the economy would have some amount of copyrighted works, public domain works, and labor endowment. In particular, the production of creative works builds on the existing stock of copyrights and the public domain (Landes and Posner 1989). For the same level of endowments, however, productive capacities might still differ between countries, and I capture all the exogenous factors under the broad category of innovativeness and label it as A_t. Let N_t denote the flow of newly created works at time t, all of which are initially copyrighted. Then, the production takes the form of $N_t = A_t F(L_t, C_t, P_t)$, where L_t denotes the size of labor endowment at time t.

The model's critical assumption is that the production function exhibits constant returns to scale technology in L_t, C_t, and P_t; that is, $F(kL_t, kC_t, kP_t) = kF(L_t, C_t, P_t)$ for all $k \geq 0$. In particular, this means that per capita production depends only on per capita copyright and public domain inputs for a given level of innovativeness. Since copyrighted works and those in the public domain are likely to be imperfect substitutes, I assume that F takes a Cobb-Douglas form; that is, $F_t = L_t^{1-\alpha-\beta} C_t^{\alpha} P_t^{\beta}$, where $\alpha > 0$, $\beta > 0$, and $\alpha + \beta < 1$. Since A_t is treated as an exogenous parameter, I assume that A_t is constant in this section. Letting $k = 1/L_t$ yields

$$n_t = A c_t^{\alpha} p_t^{\beta}, \tag{1}$$

where $n_t = N_t/L_t$, $c_t = C_t/L_t$, and $p_t = P_t/L_t$.

The remaining parts of the model describe the laws of motion that govern the evolution of the per capita stocks of copyrighted work, c_t, and the public domain, p_t. Let h, $0 < h < 1$, denote the strength of copyright protection, where the notion of protection is not necessarily based on the statutory term length, but also the degree of protection a country's copyright law provides.[4] In particular, this implies that at a rate of $1 - h$, some of the copyrighted works are infringed and effectively fall into the public domain.[5] Adding the flow variable n_t, the number of works created at time t, the evolution of per capita stock of copyrighted

[4] For example, h can be defined as the scope of copyrightable subjects or probabilistic property rights that depends on exceptions to copyright infringements.

[5] For an assessment of the effect of legislative extensions of copyright terms on the number of books that have been prevented from entering the public domain, see David and Rubin (2008).

works can be described as follows:

$$\dot{c}_t = A c_t^{\alpha} p_t^{\beta} - (1-h)c_t. \tag{2}$$

Similarly, let δ, $0 < \delta < 1$, denote the discount factor for the public domain. That is, at a rate of $1-\delta$, some of the works in the public domain become obsolete due to cultural or technological changes. Thus, I can write the evolution of per capita stock of the public domain as follows:

$$\dot{p}_t = (1-h)c_t - (1-\delta)p_t. \tag{3}$$

To characterize the behavior of this dynamical system, I find the steady states and investigate the stability properties. Let c^* and p^* denote the steady state of the two key variables. Then, c^* and p^* are the solution to the above equations, (2) and (3), when the time derivatives, $\dot{c}_t$ and $\dot{p}_t$, are set equal to zero. That is, in steady states, per capita stocks of copyrighted works and the public domain remain constant. There are two solutions to this system of equations, one of which is a trivial solution; that is, $(c^*, p^*) = (0, 0)$. Since this is an uninteresting case, from now on I refer to the following solution as the unique steady state of this system:

$$c^* = \left(\frac{A}{1-\delta}\right)^{\frac{1}{1-\alpha-\beta}} \left(\frac{1-\delta}{1-h}\right)^{\frac{1-\beta}{1-\alpha-\beta}}, \tag{4}$$

$$p^* = \left(\frac{A}{1-\delta}\right)^{\frac{1}{1-\alpha-\beta}} \left(\frac{1-\delta}{1-h}\right)^{\frac{\alpha}{1-\alpha-\beta}}. \tag{5}$$

The levels of per capita stocks of copyright and the public domain are completely determined by the parameters of the production function, the level of protection, the public domain decay rate, and the economy's innovativeness, all of which are assumed to be constant. This means that, in particular, a once-and-for-all change in any of these values would have a positive or negative effect on the levels of c^* and p^*, but it would not have any growth effects in the long run. That is, as long as the system is stable, the growth rates, $\dot{c}_t/c_t$ and $\dot{p}_t/p_t$, would approach zero towards the new steady state; outside of steady state, the supply response would be non-zero.

For concreteness, suppose that there is a permanent increase in the level of copyright protection. Intuitively, an increase in h would allow less copyrighted works to enter the public domain before their statutory term expires. Thus, the stock of copyrighted works would rise in the short run, but as it approaches the new steady state, the growth rate, $\dot{c}_t/c_t$, would become negligible. On the other hand, the economy's innovative parameter, A, might in fact change over time in which case there could be a growth effect. For instance, a country's per capita income and education may affect the production of copyrighted works, which I take into account in the empirical analysis.

The comparative statics exercise regarding the steady state is straightforward. It can be shown that both the steady state stocks of copyrighted works and the public domain increase with h, δ, and A; that is, $\partial c^*/\partial h > 0$, $\partial p^*/\partial h > 0$, $\partial c^*/\partial \delta > 0$, $\partial p^*/\partial \delta > 0$, $\partial c^*/\partial A > 0$, and $\partial p^*/\partial A > 0$. Regarding the policy variable, h, this model unambiguously predicts that stronger protection would ultimately lead to higher per capita levels of copyrighted works and the public domain, all other things being equal.[6] Higher protection would initially decrease

[6] However, this does not mean that it is necessarily welfare-improving to increase the level of copyright protection. Since my model focuses on the positive analysis, it does not include any social costs of copyrights. For instance, the deadweight loss tends to grow with copyright protection, so there is the usual trade-off in setting the optimal policy.

the size of the public domain, but in the end the increase in copyright production would compensate the loss.

In the above, I have implied that the dynamical system is stable. This is an important issue, in particular, for international copyright policies. If the system does not converge, then it possibly means that initially copyright-poor countries would be dominated by initially copyright-rich countries because the production gap would not narrow. Thus, copyright-poor countries would be especially concerned about adopting international treaties that traditionally are often led by developed countries. However, it turns out that the dynamical system has the property of global asymptotic stability, which means that the domain of attraction to the steady state is the whole space.

Figure 2 is the phase diagram that describes the evolution of c_t and p_t over time, where the arrows show the direction of motion of the two variables. That is, from equation (2), for a given p_t, the value of c_t that implies $\dot{c}_t = 0$ is given by $c_t = [A/(1-h)]^{(1/(1-\alpha))} p_t^{(\beta/(1-\alpha))}$. Since $\alpha + \beta < 1$, the $\dot{c}_t = 0$ locus is drawn as a concave function, and similarly for the $\dot{p}_t = 0$ locus. The graph shows that regardless of the initial values of c_t and p_t they converge to the unique steady state. However, it must be emphasized that this only means that for a given economy, c_t and p_t converge globally, but where they converge might be different for each country.

To make this point more precise, suppose that country X is initially endowed with both higher levels of c_t and p_t than country Y. This does not mean that country X is closer to its steady-state levels of c^* and p^* than country Y because the parameters of the model, especially the exogenous factor, A, might be different between the two countries. Thus, the notion of convergence in a cross-country comparison is conditional in the sense that the convergence is relative to the level of steady states. A useful way to analyze these quantitative implications is to linearize the dynamical system around the steady state, whose derivation is relegated to the Appendix.

The linearized system describes the behavior of c_t and p_t in the vicinity of the steady state. More specifically, c_t and p_t converge to c^* and p^* at a speed roughly proportional to its distance from the steady-state value. This implies that, if two countries have the same parameters of production technology, copyright protection, and innovative capacity, then the initially copyright-poor country tends to grow faster in terms of per capita stock of copyrighted works (and the public domain). Again, caution should be exercised when interpreting this result because the convergence is conditional on holding constant other factors that might affect the steady-state growth rates.

4 Empirical Evidence

There are three main reasons why per capita copyright production might converge across countries. First, the above model implies that, to the extent that differences in c_t and p_t arise from countries being at different positions relative to their steady states, copyright-poor countries would catch up to copyright-rich countries. Second, to the extent that copyright policies provide reciprocal national treatment, the international spillover of copyrights tends to increase the productivity of copyright-poor countries.[7] Third, to the extent that production depends on such factors as income and education, convergence in these factors would

[7] Copyright-poor countries might catch up even faster by illegally copying the materials of the rich countries. However, I abstract from this issue here because the industry or government statistics does not count pirated materials towards production.

lead to convergence in copyright production.

To test this (un)conditional convergence hypothesis, I first draw on a five-year panel data on book and film production for 39 and 29 countries, respectively, which covers the period from 1975 to 1995. UNESCO has been actively involved in collecting annual statistics on the number of titles (i.e., new editions as well as re-editions) and films produced since at least 1970 and publishes them in the *Yearbook*. That is, questionnaires are sent to its member countries requesting them to transmit the questionnaires to the appropriate authorities for completion. However, nonresponse is a serious problem. In any given year, less than half of the member countries reported (see Whitney 1995).

Thus, more than 100 countries reported at some point, but the data set has a large number of missing entries. Based on the *Yearbook*, I was able to construct a five-year balanced panel of 39 and 29 countries for book and film production, respectively, covering the period 1975–1995. In doing so, I substituted an adjacent year, or the average of the two adjacent years' data, for no more than two missing entries for any given country. To check the sensitively of the results to the choice of five-year periods, I also constructed a two-year balanced panel of 18 and 14 countries for book and film production, respectively, covering a somewhat longer period, 1970–1998 and 1971–1999.

International Publishers Association (IPA) also provides annual statistics on the number of titles published in some 50 countries for the period 1990–2000. IPA is an international publishing industry federation and presumably collects data from its member associations. However, the data provided by UNESCO and IPA are not typically the same. The size of the data discrepancy varies. In at least three countries (i.e., Brazil, India, and Italy), the difference is well over 10,000 titles. Approximately in one third of the sample countries, UNESCO data is under-inclusive, for another third, it is over-inclusive, and for the remaining third, the discrepancies are small or nonexistent.

I remain agnostic about the sources of data discrepancy. However, to check the robustness of the results, I constructed a cross-section and a four-year panel using IPA's annual book production statistics for 25 countries covering the period 1990–1998. The same substitution rule for the missing entries as described above was followed. Therefore, there are three main sources of data (i.e., UNESCO book, UNESCO film, IPA book) used in the following analysis (see Table 1 for the list of countries). The composition of the UNESCO book panel is not the same as that of the IPA sample, although 17 countries are in both data sets. The composition of the film panel is also slightly different.

The empirical specification is the standard fixed-effects model. In keeping with the growth literature, I do not use a random-effects model because the assumption that the country-specific effects are distributed independently of the explanatory variables is likely to be violated. The dependent variable is the per capita growth rate of book (or film) production during the relevant time periods, where per capita refers to the total literate population. I control for per capita GDP (logged), average years of schooling, unemployment rate (interest rate, instead, for the case of film), and time dummies as control variables. All independent variables are measured at the beginning of the periods.

To be more precise in terms of the model's prediction, although the stock of copyrighted works as well as the size of the public domain is not readily available, the flow variable of newly created copyrighted works is measurable. Equation (1) implies that the properties of c_t and p_t near the steady state carry over to per capita production of copyrighted works, n_t. That is, n_t approaches its steady-state value at a rate proportional to the those of c_t

and p_t, and the convergence property holds true for n_t. Since the number of books or films produced in each year corresponds to the flow variable N_t, the transitional dynamics can be translated into the following empirical specification:

$$\ln\left(\frac{N}{L}\right)_{i,t+1} - \ln\left(\frac{N}{L}\right)_{i,t} = b_1 \ln\left(\frac{N}{L}\right)_{i,t} + b_2 X_{i,t} + \lambda_i + \gamma_t + \varepsilon_{i,t}, \qquad (6)$$

where i and t index counties and time, λ_i captures the unobserved heterogeneity that are constant over time, γ_t is $T-1$ time dummies, and $\varepsilon_{i\,t}$ is the error term. As mentioned above, I measure the size of the labor endowment, L_t, with the total literate population in each country. That is, to be able to produce copyrighted works, I assume that the authors and artists must be literate. UNESCO provides data on adult literacy rates in a number of (mostly developing) countries every five years, with which I adjust the total population in each country. Most of the developed countries do not report literacy rates, in which case I use the estimates for the category "developed countries" to adjust total population.

If b_1 is negative, then the growth rate of per capita copyright production is inversely related to the initial level of per capita copyright production in the sample of countries selected, and the more negative the coefficient b_1, the greater the tendency for convergence. When additional control variables are suppressed, this is known as the unconditional convergence because differences in the per capita level of copyright production depend only on differences in positions relative to the common growth path. However, as previously discussed, convergence is more likely to be conditional because each country's steady state and growth path would depend on factors that are exogenous to the model.

For instance, if the initial level, n_t, is less than the steady-state level, n^*, then holding constant the initial position, a country with a higher value of A, the exogenous factor that influences copyright production, tends to have a higher growth rate than a country with a lower value of A. In the following, I assume that the exogenous productivity parameter A is correlated with the level of income and the average years of schooling because higher income and more educated population can lead to more consumption and production of cultural goods. In addition, I control for the unemployment rate or the interest rate because they represent the opportunity cost of labor and capital, which are, respectively, important for the production of books and films.

Summary statistics are presented in Table 2. Note that since these are from panel data, the dispersion is due to both within and between country variations. There is indeed a large variation in copyright growth rates in the UNESCO data. The median growth rate over five-year periods is 6 percent for books and -6 percent for films, but the standard deviations are over 50 percent in both cases. The median number of books and films produced per year is 0.26 and 0.002, respectively, per thousand literate population. These figures increase for the two-year and the IPA data because of the differences in the sample and periods. Per capita income is significantly higher for film producing countries.

Table 3 reports the estimation results using the UNESCO's five-year book production data in both pooled OLS and fixed-effects specifications. Note that when the average years of schooling and the unemployment rates are included as controls, the panel becomes unbalanced due to missing entries. In columns 1–4 of the table, the coefficients on the initial level of per capita production are estimated with a negative sign, but they are not statistically significant at the 5 percent level. Instead, copyright growth rate seems to be positively correlated with the level of per capita income, but when the unemployment rate is controlled for, the relationship is no longer significant.

This seem to suggest that there is only a weak evidence on the international convergence of copyright production, both conditionally and unconditionally. However, the fixed-effects estimation shown in columns 5–8 strongly supports both conditional and unconditional convergence within the sample. That is, after controlling for the unobserved country-specific heterogeneity, the coefficients on the initial level of copyright production become very negative and statistically significant at the 1 percent level in all four specifications. Given that the sample consists of a relatively diverse set of countries, this seems to render strong support to the convergence hypothesis.

Table 4 shows the corresponding estimation results using the UNESCO's five-year film production data. Since movies depend on financing and the industry is often said to be recession proof, I include the interest rate instead of the unemployment rate as a control variable. The pooled OLS as well as the fixed-effects estimates of the convergence coefficient are all negative and statistically significant at the 1 percent level. Thus, the data once again support the convergence hypothesis for the sample period. In both data sets, controlling for the unobserved heterogeneity substantially increases the estimates of b_1, implying faster convergence of per capita copyright production.

In particular, the coefficients on per capita income are significant in the OLS estimation but insignificant in the fixed-effects estimation. This suggests that although high income countries' film production seems to grow fast, after controlling for the unobserved heterogeneity, this effect is dominated by the effects of convergence. On the other hand, the coefficients on per capita income are significant in both OLS and fixed-effects specifications in the case of book production, which implies that there may be an additional growth effect due to the country's level of income. That is, a high income country may have a higher level of steady state, facilitating the growth.

As long as there are exogenous productivity differences among the countries that have growth effects, a policy implication is that copyright-poor countries may want to increase the level of copyright protection (i.e., h in the model) in order to increase per capita copyright production using the forces of convergence. That is, the comparative statics results suggest that the steady-state level of copyrighted works is increasing in the level of effective protection. Thus, by increasing protection, a country sets itself a high bar, and for a given initial per capita stock of copyrighted works, this would increase the growth rate of copyright production other things being equal.

Since a country's level of income appears positively correlated with copyright growth rates in Tables 3 and 4, developing countries might prefer stronger copyright protection for the above reason holding everything else constant. As long as low-income, copyright-poor countries prefer to establish stronger copyright protection in order to catch up the developed countries' copyright growth rates, this could make international copyright harmonization difficult. Despite this conjecture, however, developing countries are typically perceived as preferring weaker enforcement of copyright laws. Since my model does not consider piracy, caution must be exercised in interpreting this implication.

On the other hand, during the sample period 1975–1995, international copyright policies were more or less harmonized and stable across countries due to the adoption of major international conventions.[8] Thus, holding the production technology and the public domain decay

[8] That is, before or around 1975, all sample countries had rectified one or more of the three major multilateral copyright treaties (i.e., Berne, UCC Geneva, or UCC Paris). TRIPS came into force in 1995, which automatically applies to all WTO members.

rate constant, the empirical findings are consistent with the model prediction that copyright harmonization would contribute to cross-country copyright convergence. However, the model has no implication as to whether copyright convergence would lead to copyright harmonization. It seems more realistic that the adoption of multilateral treaties by governments was done without regard to the convergence hypothesis.

The above findings appear robust to alternative specifications and different data set. Table 5 presents the same estimation results using a two-year, rather than five-year, panel of UNESCO's book and film production data. Due to missing entries, I could not include any other control variables than the per capita income. Accordingly, the samples consist of a smaller set of countries, but the periods covered extend from 20 to 30 years. The qualitative results remain the same. In book production, the convergence hypothesis is supported when the country-specific heterogeneity is controlled for, and in film production, the coefficients on the initial level of production are significant in all specifications.

Finally, Table 6 contains a replication of the above regressions using a cross-section and a four-year panel data provided by the International Publishers Association. The sample consists of 25 countries, and the data covers the period 1990–1998. In columns 1–3, the convergence coefficient is significant only at the 10 percent level, but in column 4, it is significant at the 1 percent level. Moreover, the results in columns 4–8 strongly support the convergence hypothesis within this sample. That is, in fixed-effects estimation, the coefficients increase in absolute value and are statistically significant at the 1 percent level regardless of whether I control for the income, schooling, or unemployment rate.

5 Conclusion

In setting a country's copyright policy, especially with regard to international harmonization of copyright policies, an important and previously neglected question is how the country's copyright production would evolve and what would be the policy implications for the long-run stock of copyrighted works. This paper provides a dynamic framework based on a constant-returns-to-scale technology that succinctly describes the evolution of stocks of copyrighted works and those in the public domain. A central prediction of the model was that the steady state is asymptotically stable, and copyright growth would depend on the position of the economy relative to the steady state.

I then tested the convergence hypothesis using the annual book and film production data of some 30 countries over the period 1975–1995. The empirical evidence supports the above prediction reasonably well. That is, if countries did not vary in their levels of income and other variables, there would be a tendency for copyright-poor countries to grow faster than copyright-rich ones in terms of per capita production.[9] The results in this paper, however, leave unexplained a relatively large variation in copyright growth rates of especially low-income, copyright-poor countries, which is left for future research.

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[9] Another possibility, not explored in this paper, is that countries subsidize domestic cultural productions to reduce the balance of trade deficit in cultural goods. Such policies could have affected countries with a low initial level of cultural production.

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6 Appendix

Taylor approximations to equations (2) and (3) around c^* and p^* yields

$$\widetilde{\dot{c}} = [\beta A(c^*)^\alpha (p^*)^{\beta-1}](p-p^*) + [\alpha A(c^*)^{\alpha-1}(p^*)^\beta - (1-h)](c-c^*), \tag{7}$$

$$\widetilde{\dot{p}} = -(1-\delta)(p-p^*) + (1-h)(c-c^*). \tag{8}$$

Define $\tilde{c} = c - c^*$ and $\tilde{p} = p - p^*$. Note that at the steady state, $A(c^*)^\alpha (p^*)^\beta = (1-h)c^* =$

$(1-\delta)p^*$. I can thus rewrite equation (7) as

$$\widetilde{\dot{c}} = \beta(1-\delta)(p-p^*) - (1-\alpha)(1-h)(c-c^*). \tag{9}$$

Dividing both sides of equation (9) by $\tilde{c}$ and both sides of equation (8) by $\tilde{p}$ yields expressions for the growth rates of $\tilde{c}$ and $\tilde{p}$. Since these growth rates depend only on the ratio of $\tilde{c}$ and $\tilde{p}$, this means that if this ratio is not changing (i.e., if the economy is on a straight path such as AA or BB line in Figure 2), the growth rates of $\tilde{c}$ and $\tilde{p}$ are not changing either. Let ϕ denote this common growth rates of $\tilde{c}$ and $\tilde{p}$. Then equations (8) and (9) imply

$$\phi = \beta(1-\delta)(\tilde{p}/\tilde{c}) - (1-\alpha)(1-h), \tag{10}$$

$$\phi = -(1-\delta) + (1-h)(\tilde{c}/\tilde{p}). \tag{11}$$

Combining (10) and (11), ϕ is the solution to the following quadratic equation:

$$\phi^2 + [(1-\alpha)(1-h) + (1-\delta)]\phi + (1-\alpha-\beta)(1-\delta)(1-h) = 0. \tag{12}$$

If the linearized system is to be asymptotically stable, then the two roots must be negative. It can be readily verified that this is indeed true, so the evolution of c and p on the paths that directly converge to the steady state can be described as $c_t = c^* + e^{\phi t}[c_0 - c^*]$ and $p_t = p^* + e^{\phi t}[p_0 - p^*]$, where c_0 and p_0 denote the initial values. Since any values of c_0 and p_0 can be expressed as a combination of a point on AA line and a point on BB line, the evolution of c and p is the sum of those starting at respective points on each line. Therefore, c and p converges to the steady state everywhere near the steady state.

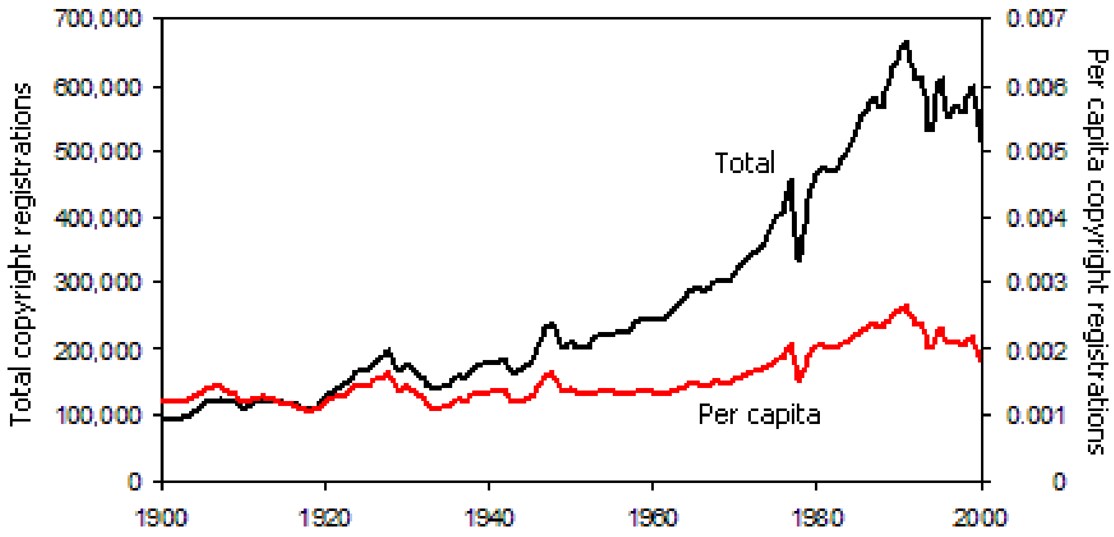

Figure 1: Copyright Registrations in the United States: 1900–2000.

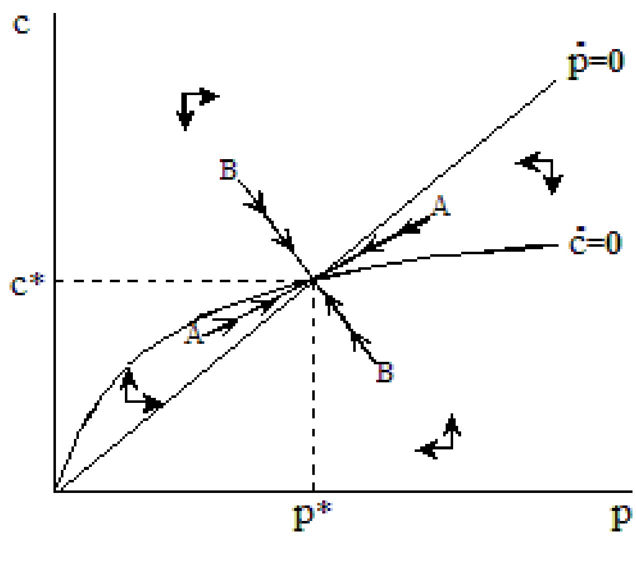

Figure 2: Phase Diagram.

Book production IPA (*N=25*)	Argentina, Brazil, Chile, Colombia, Denmark, Finland, France, Germany, Greece, Hungary, India, Italy, Japan, Korea, Latvia, Lithuania, Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland, UK, USA
Book production UNESCO (*N=39*)	*Argentina,* Austria, Belgium, *Bulgaria,* Chile, Cuba, *Denmark, Finland, France,* Greece, Guyana, *Hungary, India,* Indonesia, *Italy,* Kenya, Korea, Luxembourg, Madagascar, Malawi, *Malaysia,* Malta, Mauritius, Mexico, Nigeria, *Norway, Peru, Poland, Portugal, Romania, Spain, Sri Lanka, Sweden, Switzerland,* Thailand, Tunisia, Turkey, United States, Uruguay
Film production UNESCO (*N=29*)	Australia, Austria, *Belgium, Bulgaria, Denmark, Finland, France,* Greece, Hungary, India, Indonesia, Iran, Ireland, *Italy,* Japan, *Korea,* Malaysia, Mexico, Netherlands, *Norway,* Pakistan, *Poland,* Portugal, *Romania, Spain, Sweden, Switzerland, United Kingdom,* United States

Table. 1: List of Countries in the Samples. For the UNESCO data, countries that are both in the five-year and the two-year panels are italicized.

	UNESCO book 5-year (N=156)		UNESCO book 2-year (N=252)		UNESCO film 5-year (N=116)		UNESCO film 2-year (N=196)		IPA book 8-year (N=25)		IPA book 4-year (N=50)	
	Median	Std. dev.	Median	Std. dev.	Median	Std. dev.	Median	Std. dev.	Median	Std. dev.	Median	Std. dev.
Copyright growth rate (p.c.)	0.06	0.53	0.03	0.24	-0.06	0.68	-0.01	0.38	0.32	0.34	0.14	0.27
Per capita copyright production	0.26	5.06	0.58	0.64	0.002	0.001	0.002	0.001	0.68	0.52	0.70	0.52
Per capita income	2282	7214	3110	9159	6087	7563	8179	9586	13409	10944	13261	11205
Average years of schooling	6.47	2.27			7.78	2.37			8.93	2.15	8.95	2.16
Unemployment rate	5.21	4.17							5.85	4.40	7.10	4.96
Interest rate					10.90	8.95						

Table. 2: Summary Statistics. The unit of observation is per country and per year. For copyright production, per capita refers to the literate population (in thousands). Per capita GDP is at current prices in U.S. dollars. Average years of schooling is from Barro and Lee (2001). Unemployment rate is from IMF and ILO. Interest rate refers to the treasury bill rate and is from IMF.

Dependent variable	5-year growth rate of per capita book production							
	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) FE	(6) FE	(7) FE	(8) FE
Per capita production of titles	-0.012	-0.094	-0.162*	-0.061	-0.983***	-1.111***	-1.126***	-0.807***
	(0.047)	(0.064)	(0.090)	(0.056)	(0.165)	(0.119)	(0.120)	(0.143)
Per capita income		0.141***	0.135**	0.004		0.519***	0.365**	0.167
		(0.048)	(0.062)	(0.059)		(0.147)	(0.175)	(0.178)
Average years of schooling			0.036	-0.001			0.107	-0.038
			(0.028)	(0.027)			(0.069)	(0.097)
Unemployment rate				0.000				0.020
				(0.008)				(0.014)
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	156	156	140	70	156	156	140	70
R^2	0.037	0.100	0.124	0.162	0.570	0.615	0.653	0.664

Table. 3: Books: 5-year pooled and panels, UNESCO data (1975–1995). All independent variables refer to the figures at the beginning of the 5-year period. Per capita for production variables refers to the total literate population. Standard errors are in the parentheses and based on White's heteroskedasticity consistent variance matrix. Estimates of the intercept and the time dummies are omitted. *10%, **5%, ***1%.

Dependent variable	5-year growth rate of per capita film production							
	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) FE	(6) FE	(7) FE	(8) FE
Per capita production of films	-0.440***	-0.462***	-0.462***	-0.647***	-1.062***	-1.077***	-1.097***	-1.147***
	(0.084)	(0.085)	(0.086)	(0.153)	(0.155)	(0.135)	(0.130)	(0.185)
Per capita income		0.120***	0.113**	0.631**		0.412	0.418	0.953
		(0.043)	(0.051)	(0.294)		(0.298)	(0.286)	(0.883)
Average years of schooling			0.006	-0.041			-0.137	-0.087
			(0.028)	(0.043)			(0.140)	(0.377)
Interest rate				0.002				0.002
				(0.014)				(0.008)
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	116	116	116	59	116	116	116	59
R^2	0.222	0.266	0.266	0.442	0.530	0.544	0.550	0.647

Table. 4: Films: 5-year pooled and panels, UNESCO data (1975–1995). All independent variables refer to the figures at the beginning of the 5-year period. Per capita for production variables refers to the total literate population. Standard errors are in the parentheses and based on White's heteroskedasticity consistent variance matrix. Estimates of the intercept and the time dummies are omitted. *10%, **5%, ***1%.

Dependent variable	2-year growth rate of per capita book production				2-year growth rate of per capita film production			
	(1) OLS	(2) OLS	(3) FE	(4) FE	(5) OLS	(6) OLS	(7) FE	(8) FE
Per capita production of titles	-0.004	-0.048	-0.317***	-0.326***	-0.160***	-0.215***	-0.524***	-0.534***
	(0.018)	(0.031)	(0.083)	(0.095)	(0.050)	(0.053)	(0.074)	(0.076)
Per capita income		0.048**		0.027		0.102***		0.174
		(0.022)		(0.087)		(0.033)		(0.142)
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	252	252	252	252	196	196	196	196
R^2	0.081	0.102	0.243	0.244	0.133	0.188	0.336	0.355

Table. 5: Books and Films: 2-year panels, UNESCO data (1970–1998; 1971–1999). All independent variables refer to the figures at the beginning of the 2-year period. Per capita for production variables refers to the total literate population. Standard errors are in the parentheses and based on White's heteroskedasticity consistent variance matrix. Estimates of the intercept and the time dummies are omitted. *10%, **5%, ***1%.

Dependent variable	8-year growth rate of per capita book production				4-year growth rate of per capita book production			
	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) FE	(6) FE	(7) FE	(8) FE
Per capita production of titles	-0.151	-0.204*	-0.194*	-0.200***	-1.228***	-1.112***	-1.169***	-1.142***
	(0.095)	(0.104)	(0.096)	(0.068)	(0.175)	(0.175)	(0.187)	(0.169)
Per capita income		0.056	0.069	0.036		-0.260	-0.071	-0.015
		(0.093)	(0.094)	(0.093)		(0.228)	(0.321)	(0.304)
Average years of schooling			-0.019	-0.049*			-0.030	-0.017
			(0.032)	(0.026)			(0.050)	(0.073)
Unemployment rate				0.002				0.016**
				(0.008)				(0.007)
Time dummy	-	-	-	-	Yes	Yes	Yes	Yes
N	25	25	25	22	50	50	48	44
R^2	0.155	0.176	0.186	0.411	0.809	0.822	0.828	0.842

Table. 6: Books: 8-year cross section and 4-year panels, IPA Data (1990–1998). All independent variables refer to the figures at the beginning of the period (i.e., 1990, 1994). Per capita for production variables refers to the total literate population. Standard errors are in the parentheses and based on White's heteroskedasticity consistent variance matrix. Estimates of the intercept and the time dummy are omitted. *10%, **5%, ***1%.